

APPENDIX I

PROJECTED AIR QUALITY MODELING EFFECTS AT NOAA'S WALKER BRANCH MONITORING TOWER

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I. PROJECTED AIR QUALITY MODELING EFFECTS AT NOAA'S WALKER BRANCH MONITORING TOWER

1.0 BACKGROUND

National Oceanic and Atmospheric Administration (NOAA) has an ongoing research program within the Walker Branch Watershed investigating the ramifications of global climate change. As part of this research program, NOAA has been collecting information on CO₂ and heat flux across the forest canopy for approximately 5 years. This research program is expected to continue for many years.

DOE is proposing to construct and operate the Spallation Neutron Source (SNS), on the preferred location, Chestnut Ridge, that is approximately 1.5 km west of the NOAA research tower. The SNS will have mechanical draft cooling towers to dissipate excess heat and will use natural gas as a fuel for general space heating. This study is designed to provide a preliminary assessment of the potential impacts that the SNS may have in the quality of the data from the NOAA research tower. The overall study is designed to provide information on the impacts associated with water vapor in the cooling plume, and CO₂ and NO_x released from the combustion of natural gas.

2.0 AIR QUALITY MODEL

EPA's backbone air quality model, the Industrial Source Complex Short Term (ISCST3, version 97363) model, was chosen to assess the effects from the sources of concern at the SNS. The ISCST3 model is a complex, straight-line, steady-state Gaussian plume model that can be used to model a number of sources that might be present at a typical industrial facility.

The ISCST3 model accepts hourly meteorological data to define the conditions for plume rise, transport, diffusion, and deposition. Output from the model can take many forms; but, it generally consists of an echo of the input runstream, summary of all modeling inputs, and modeling results summarized in several requestable formats (U.S.E.P.A., 1995).

2.1 Model Input

Input to the ISCST3 model is of two basic types: (1) the input runstream file, and (2) the meteorological data file.

2.1.1 Input Runstream

This file contains the selected modeling options, as well as source location and parameter data, receptor locations, meteorological data file specifications, and output options.

For this “Phase I” study two groups of sources were modeled: (1) the cooling towers for water vapor emissions, and (2) a group of ten (4 MW scenario) small boiler stacks located on various SNS structures for CO₂ and NO_x emissions.

The 13 adjacent cooling towers (cells) present were modeled as a single combined source with an overall water vapor emission rate of 350 gallons/minute and other stack parameters as supplied by Conventional Facilities Team personnel. The 10 boiler stacks were modeled as discrete point sources. Stack diameters and heights were provided as indicated previously, while exit velocities and temperatures were based upon an average value taken from boiler manufacture literature. Existing boiler emission rates were taken from AP42 (U.S.E.P.A., 1995) and are summarized below:

| Combustion Products from Natural Gas-Fired Boilers at SNS | | |
|------------------------------------------------------------------|------------------------------------|----------------------------------|
| Combustion Products | Rate (lbs/mmcf)¹ | Rate (lbs/hr)² |
| NO _x | 100 | 3.48 |
| CO ₂ | 1.2E+05 | 4184 |

¹ Emission factors from EPA AP42 for commercial boilers (rating 0.3 to 10 mmBtu/hr)

² Based on cumulative output of 10 boilers at SNS with total heat load of 34,870,000 Btu/hr (0.0349 mmcf/hr).

Universal Traverse Mercator (UTM) coordinates, defining the location of each source in meters, were also provided to the model as well as source elevations. These locations along with source elevations were provided to the model. Input of source elevation data allows the model to perform intermediate and complex terrain calculations (via the incorporated COMPLEX I model). Complex terrain is defined as those receptor locations with elevations greater than a modeled stack top release elevation. For this study, only one receptor location was used (the NOAA monitoring tower location). This receptor also had a “flagpole” elevation (36 m) input that requests that the model provide concentrations 36 m from the ground elevation (where the instruments are located on the tower).

Building parameters were also input to the model to implement building downwash procedures. Other pertinent information input to the model included the use of “rural” wind profile exponents, vertical temperature gradients and mixing heights, and selection of the regulatory default option that sets a number of specific options to a selected default value.

2.1.2 Meteorological Data

Surface meteorological data supplied to the model consisted of one year (1991) of 15 minute averages for wind direction, mean wind speed, ambient temperature, solar radiation, and sigma-theta collected at NOAA’s Walker Branch monitoring tower. Missing data were filled using data from additional nearby towers or by averaging surrounding period data for short missing periods. Solar radiation and sigma-theta are not used directly by the ISCST3 model but used (by the method indicated in Sect. 6.4.4.4. of U.S.E.P.A., 1987) to calculate stability category. This procedure was modified to reflect a surface roughness of 1.2 m and effective anemometer height of 9.1 m as suggested for the Walker Branch site by NOAA personnel.

A Fortran code was prepared to read these data, convert to the correct units when necessary, and write the values out to a new file in the correct format for ISCST3 use. Upper air data (mixing heights) were also taken from a preprocessed file of Knoxville/Nashville, TN 1991 surface/upper air data compiled from data downloaded from EPA's SCRAM bulletin board. Linear - interpolation was used to provide a mixing height for each 15-minute average from the 1-hour averages provided in the preprocessed file. All wind speeds less than 0.7 m/sec were considered a calm and set to zero (not processed by the model).

2.2 Model Output

Output from the ISCST3 model runs was somewhat different than normally expected in that the meteorological data utilized were 15-minute average data rather than 1-hour data. For this reason, while the model indicates 1 hour averages are output, the averages are actually 15-minute averages. The dates shown for the output concentrations are incorrect because they were being advanced by a factor of four. Additionally, since four times as much meteorological data are present as normal to an annual model run, four separate runs (each quarter year or approximately three months) were preformed to cover the entire year of Walker Branch, 15-minute data.

Actual model output consisted of 15-minute averages (in micrograms/cubic meter) of water vapor for the cooling tower and CO₂ and NO_x concentrations for the ten boiler stacks output at the monitoring tower location. The printed output consisted of a set of tables summarizing the maximum 50 concentrations for each of the modeled releases and two additional files listing the concentrations for every 15-minute period and every non-zero concentration, respectively. Approximately 80 – 85 percent of all projected concentrations at the tower are zeros (due mainly to wind direction not blowing from the sources toward the tower during that time).

ISCST3-projected maximums were 1.04 g/m³ for water vapor, 27,569 µg/m³ for CO₂ and 23 µg/m³ for NO_x. A copy of the ISCST3 output for the third quarter modeled is included in this appendix.

One important factor in considering the concentrations obtained is that these are conservative, probably worst-case, projections. The emission rates assume continuous, annual operation of all sources at full-rated capacity. The 350 gal/min emission rate for the cooling towers is for "droplet and vapor drag out." For modeling purposes, the assumption was made that this water is all vapor or aerosol. In reality, some larger droplets may be present and more may form as the plume travels downwind. These particles may condense or drop out before ever reaching the monitoring tower. The extent of this phenomena would probably be highly dependent upon local ambient meteorological conditions at any given time.

3.0 REFERENCES

U.S.E.P.A. 1995. *Compilation of Air Pollution Emission Factors, 5th Edition*. AP-42. OAQPS. Research Triangle Park, North Carolina.

U.S.E.P.A. 1987. *On-Site Meteorological Program Guidance for Regulatory Modeling Applications*. OAQPS. Research Triangle Park, North Carolina.

U.S.E.P.A. 1995. *User's Guide for the Industrial Source Complex Dispersion Models*. OAQPS. Research Triangle Park, North Carolina.

CO STARTING
CO TITLEONE CT & 10 STACKS @ MON. TOWER*4MW*1991 JUL-SEP WB MET
CO MODELOPT DEFAULT CONC RURAL
*** ave time is really 15 min per met data
CO AVERTIME 1
CO POLLUTID OTHER
CO TERRHGT5 ELEV
CO FLAGPOLE
CO DCAYCOEF 0.000000E+00
CO RUNORNOT RUN
CO ERRORFIL ERRORS.OUT
CO FINISHED

SO STARTING
SO ELEVUNIT FEET

| *** Source Location Cards: *** SRCID SRCTYP | XS | YS | ZS |
|------------------------------------------------|---------|----------|--------|
| SO LOCATION CT1 POINT | 743267. | 3981595. | 1040.0 |
| *** COOLING TOWER | | | |
| SO LOCATION S1C POINT | 742933. | 3981537. | 1039.5 |
| *** FRONT END BLDG. | | | |
| SO LOCATION S2C POINT | 743170. | 3981701. | 1054.0 |
| *** KLYSTRON HALL | | | |
| SO LOCATION S3C POINT | 743471. | 3981795. | 1088.0 |
| *** RING SERVICE BLDG. | | | |
| SO LOCATION S4C POINT | 743552. | 3981865. | 1041.0 |
| *** RTBT SERVICE BLDG. | | | |
| SO LOCATION S5C POINT | 743645. | 3981965. | 1038.5 |
| *** TARGET BLDG. | | | |
| SO LOCATION S6C POINT | 743239. | 3981635. | 1050.0 |
| *** UTILITY BLDG. | | | |
| SO LOCATION S7C POINT | 743347. | 3981717. | 1050.0 |
| *** OFFICE BLDG. | | | |
| SO LOCATION S8C POINT | 743567. | 3982073. | 1038.5 |
| *** TARGET BLDG. | | | |
| SO LOCATION S9C POINT | 743339. | 3981977. | 1088.0 |
| *** RING SERVICE BLDG. | | | |
| SO LOCATION S10C POINT | 743447. | 3982027. | 1041.0 |
| *** RTBT SERVICE BLDG. | | | |
| *** Source Parameter Cards: | | | |
| *** POINT: SRCID QS | HS | TS | VS DS |
| *** VOLUME: SRCID QS | HS | SYINIT | SZINIT |
| *** AREA: SRCID QS | HS | XINIT | |

*** WATER VAPOR EMISSIONS (350GPM) FROM COOLING TOWERS (13 COMBINED)

| SO SRCPARAM | CT1 | 22015. | 7.52 | 304.80 | 9.8000 | 4.8800 |
|-----------------------------------------|------|-----------|---------|----------|--------|--------|
| *** CO2 EMISSIONS FROM 10 BOILER STACKS | | | | | | |
| SO SRCPARAM | S1C | 55.2300 | 13.5600 | 480.0000 | 7.1800 | .4064 |
| SO SRCPARAM | S2C | 43.1500 | 9.1400 | 480.0000 | 7.1800 | .3048 |
| SO SRCPARAM | S3C | 55.2300 | 8.5300 | 480.0000 | 7.1800 | .4064 |
| SO SRCPARAM | S4C | 28.2900 | 14.9300 | 480.0000 | 7.1800 | .2540 |
| SO SRCPARAM | S5C | 102.73000 | 20.4200 | 480.0000 | 7.1800 | .4064 |
| SO SRCPARAM | S6C | 37.4200 | 7.9200 | 480.0000 | 7.1800 | .3048 |
| SO SRCPARAM | S7C | 19.6600 | 11.5800 | 480.0000 | 7.1800 | .2040 |
| SO SRCPARAM | S8C | 102.73000 | 20.4200 | 480.0000 | 7.1800 | .4064 |
| SO SRCPARAM | S9C | 55.2300 | 8.5300 | 480.0000 | 7.1800 | .4064 |
| SO SRCPARAM | S10C | 28.2900 | 14.9300 | 480.0000 | 7.1800 | .2540 |
| SO BUILDHGT | CT1 | 7.52 | 7.52 | 7.52 | 7.52 | 7.52 |
| SO BUILDHGT | CT1 | 7.52 | 7.52 | 7.52 | 7.52 | 7.52 |
| SO BUILDHGT | CT1 | 7.52 | 7.52 | 7.52 | 7.52 | 7.52 |
| SO BUILDHGT | CT1 | 7.52 | 7.52 | 7.52 | 7.52 | 7.52 |
| SO BUILDHGT | CT1 | 7.52 | 7.52 | 7.52 | 7.52 | 7.52 |
| SO BUILDHGT | CT1 | 7.52 | 7.52 | 7.52 | 7.52 | 7.52 |
| SO BUILDWID | CT1 | 79.02 | 67.64 | 54.21 | 39.13 | 22.86 |
| SO BUILDWID | CT1 | 36.20 | 50.87 | 64.00 | 75.18 | 84.08 |
| SO BUILDWID | CT1 | 94.02 | 96.76 | 98.21 | 97.74 | 94.30 |
| SO BUILDWID | CT1 | 79.02 | 67.64 | 54.21 | 39.13 | 22.86 |
| SO BUILDWID | CT1 | 36.20 | 50.87 | 64.00 | 75.18 | 84.08 |
| SO BUILDWID | CT1 | 94.02 | 96.76 | 98.21 | 97.74 | 94.30 |
| SO BUILDHGT | S1C | 10.52 | 10.52 | 10.52 | 10.52 | 10.52 |
| SO BUILDHGT | S1C | 10.52 | 10.52 | 10.52 | 10.52 | 10.52 |
| SO BUILDHGT | S1C | 10.52 | 10.52 | 10.52 | 10.52 | 10.52 |
| SO BUILDHGT | S1C | 10.52 | 10.52 | 10.52 | 10.52 | 10.52 |
| SO BUILDHGT | S1C | 10.52 | 10.52 | 10.52 | 10.52 | 10.52 |
| SO BUILDHGT | S1C | 10.52 | 10.52 | 10.52 | 10.52 | 10.52 |
| SO BUILDWID | S1C | 39.57 | 37.93 | 35.14 | 31.28 | 26.48 |
| SO BUILDWID | S1C | 28.53 | 29.72 | 30.00 | 31.69 | 33.41 |
| SO BUILDWID | S1C | 33.79 | 32.43 | 34.14 | 37.25 | 39.22 |
| SO BUILDWID | S1C | 39.57 | 37.93 | 35.14 | 31.28 | 26.48 |
| SO BUILDWID | S1C | 28.53 | 29.72 | 30.00 | 31.69 | 33.41 |
| SO BUILDWID | S1C | 33.79 | 32.43 | 34.14 | 37.25 | 39.22 |
| SO BUILDHGT | S2C | 6.10 | 6.10 | 6.10 | 6.10 | 6.10 |
| SO BUILDHGT | S2C | 6.10 | 6.10 | 6.10 | 6.10 | 6.10 |
| SO BUILDHGT | S2C | 6.10 | 6.10 | 6.10 | 6.10 | 6.10 |
| SO BUILDHGT | S2C | 6.10 | 6.10 | 6.10 | 6.10 | 6.10 |
| SO BUILDHGT | S2C | 6.10 | 6.10 | 6.10 | 6.10 | 6.10 |
| SO BUILDHGT | S2C | 6.10 | 6.10 | 6.10 | 6.10 | 6.10 |
| SO BUILDWID | S2C | 394.37 | 329.75 | 255.11 | 172.73 | 85.09 |
| SO BUILDWID | S2C | 159.19 | 242.78 | 319.00 | 385.52 | 440.33 |
| SO BUILDWID | S2C | 508.55 | 519.89 | 519.11 | 510.34 | 486.05 |
| SO BUILDWID | S2C | 394.37 | 329.75 | 255.11 | 172.73 | 85.09 |
| SO BUILDWID | S2C | 159.19 | 242.78 | 319.00 | 385.52 | 440.33 |
| SO BUILDWID | S2C | 508.55 | 519.89 | 519.11 | 510.34 | 486.05 |

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|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| SO BUILDHGT S3C | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 |
| SO BUILDHGT S3C | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 |
| SO BUILDHGT S3C | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 |
| SO BUILDHGT S3C | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 |
| SO BUILDHGT S3C | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 |
| SO BUILDHGT S3C | 33.19 | 32.38 | 30.58 | 27.85 | 26.25 | 29.31 | 26.25 | 29.31 | 29.31 |
| SO BUILDWID S3C | 32.21 | 34.12 | 35.00 | 34.82 | 33.57 | 31.31 | 33.57 | 31.31 | 31.31 |
| SO BUILDWID S3C | 28.10 | 24.20 | 26.58 | 29.64 | 31.80 | 33.00 | 31.80 | 33.00 | 33.00 |
| SO BUILDWID S3C | 33.19 | 32.38 | 30.58 | 27.85 | 26.25 | 29.31 | 26.25 | 29.31 | 29.31 |
| SO BUILDWID S3C | 32.21 | 34.12 | 35.00 | 34.82 | 33.57 | 31.31 | 33.57 | 31.31 | 31.31 |
| SO BUILDWID S3C | 28.10 | 24.20 | 26.58 | 29.64 | 31.80 | 33.00 | 31.80 | 33.00 | 33.00 |
| SO BUILDHGT S4C | 17.37 | 17.37 | 17.37 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 |
| SO BUILDHGT S4C | 17.37 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 |
| SO BUILDHGT S4C | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 17.37 | 5.49 | 17.37 | 17.37 |
| SO BUILDHGT S4C | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 |
| SO BUILDHGT S4C | 17.37 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 |
| SO BUILDHGT S4C | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 17.37 | 5.49 | 17.37 | 17.37 |
| SO BUILDWID S4C | 115.69 | 109.86 | 100.69 | 14.41 | 10.95 | 10.69 | 10.95 | 10.69 | 10.69 |
| SO BUILDWID S4C | 83.96 | 18.08 | 21.00 | 23.29 | 24.86 | 25.69 | 24.86 | 25.69 | 25.69 |
| SO BUILDWID S4C | 25.73 | 24.99 | 23.49 | 23.32 | 23.52 | 118.00 | 23.52 | 118.00 | 118.00 |
| SO BUILDWID S4C | 115.69 | 109.86 | 100.69 | 88.46 | 73.55 | 67.40 | 73.55 | 67.40 | 67.40 |
| SO BUILDWID S4C | 83.96 | 18.08 | 21.00 | 23.29 | 24.86 | 25.69 | 24.86 | 25.69 | 25.69 |
| SO BUILDWID S4C | 25.73 | 24.99 | 23.49 | 23.32 | 23.52 | 118.00 | 23.52 | 118.00 | 118.00 |
| SO BUILDHGT S5C | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 |
| SO BUILDHGT S5C | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 |
| SO BUILDHGT S5C | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 |
| SO BUILDHGT S5C | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 |
| SO BUILDHGT S5C | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 |
| SO BUILDHGT S5C | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 |
| SO BUILDWID S5C | 115.69 | 109.86 | 100.69 | 88.46 | 73.55 | 67.40 | 73.55 | 67.40 | 67.40 |
| SO BUILDWID S5C | 83.96 | 97.97 | 109.00 | 116.72 | 120.90 | 121.40 | 120.90 | 121.40 | 121.40 |
| SO BUILDWID S5C | 118.21 | 111.43 | 104.84 | 111.91 | 116.73 | 118.00 | 116.73 | 118.00 | 118.00 |
| SO BUILDWID S5C | 115.69 | 109.86 | 100.69 | 88.46 | 73.55 | 67.40 | 73.55 | 67.40 | 67.40 |
| SO BUILDWID S5C | 83.96 | 97.97 | 109.00 | 116.72 | 120.90 | 121.40 | 120.90 | 121.40 | 121.40 |
| SO BUILDWID S5C | 118.21 | 111.43 | 104.84 | 111.91 | 116.73 | 118.00 | 116.73 | 118.00 | 118.00 |
| SO BUILDHGT S6C | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 |
| SO BUILDHGT S6C | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 |
| SO BUILDHGT S6C | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 |
| SO BUILDHGT S6C | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 |
| SO BUILDHGT S6C | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 |
| SO BUILDHGT S6C | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 | 4.88 |
| SO BUILDWID S6C | 47.16 | 42.88 | 37.30 | 30.59 | 22.95 | 23.11 | 22.95 | 23.11 | 23.11 |

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|------------------|--------|--------|--------|--------|--------|--------|
| SO BUILDWID S6C | 31.09 | 38.12 | 44.00 | 48.54 | 51.61 | 53.11 |
| SO BUILDWID S6C | 52.99 | 51.26 | 49.30 | 51.09 | 51.32 | 50.00 |
| SO BUILDWID S6C | 47.16 | 42.88 | 37.30 | 30.59 | 22.95 | 23.11 |
| SO BUILDWID S6C | 31.09 | 38.12 | 44.00 | 48.54 | 51.61 | 53.11 |
| SO BUILDWID S6C | 52.99 | 51.26 | 49.30 | 51.09 | 51.32 | 50.00 |
| SO BUILDHGT S7C | 8.53 | 8.53 | 8.53 | 8.53 | 8.53 | 8.53 |
| SO BUILDHGT S7C | 8.53 | 8.53 | 8.53 | 8.53 | 8.53 | 8.53 |
| SO BUILDHGT S7C | 8.53 | 8.53 | 8.53 | 8.53 | 8.53 | 8.53 |
| SO BUILDHGT S7C | 8.53 | 8.53 | 8.53 | 8.53 | 8.53 | 8.53 |
| SO BUILDHGT S7C | 8.53 | 8.53 | 8.53 | 8.53 | 8.53 | 8.53 |
| SO BUILDWID S7C | 51.21 | 54.85 | 56.84 | 57.09 | 55.61 | 55.50 |
| SO BUILDWID S7C | 58.94 | 61.41 | 62.00 | 60.71 | 57.58 | 52.69 |
| SO BUILDWID S7C | 46.26 | 41.42 | 44.11 | 45.45 | 45.42 | 46.00 |
| SO BUILDWID S7C | 51.21 | 54.85 | 56.84 | 57.09 | 55.61 | 55.50 |
| SO BUILDWID S7C | 58.94 | 61.41 | 62.00 | 60.71 | 57.58 | 52.69 |
| SO BUILDWID S7C | 46.26 | 41.42 | 44.11 | 45.45 | 45.42 | 46.00 |
| SO BUILDHGT S8C | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 |
| SO BUILDHGT S8C | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 |
| SO BUILDHGT S8C | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 |
| SO BUILDHGT S8C | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 |
| SO BUILDHGT S8C | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 |
| SO BUILDWID S8C | 113.02 | 106.61 | 96.96 | 84.36 | 69.20 | 68.80 |
| SO BUILDWID S8C | 83.87 | 96.40 | 106.00 | 112.38 | 115.34 | 114.80 |
| SO BUILDWID S8C | 110.77 | 103.37 | 103.96 | 111.40 | 115.45 | 116.00 |
| SO BUILDWID S8C | 113.02 | 106.61 | 96.96 | 84.36 | 69.20 | 68.80 |
| SO BUILDWID S8C | 83.87 | 96.40 | 106.00 | 112.38 | 115.34 | 114.80 |
| SO BUILDWID S8C | 110.77 | 103.37 | 103.96 | 111.40 | 115.45 | 116.00 |
| SO BUILDHGT S9C | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 |
| SO BUILDHGT S9C | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 |
| SO BUILDHGT S9C | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 |
| SO BUILDHGT S9C | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 |
| SO BUILDHGT S9C | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 |
| SO BUILDWID S9C | 34.35 | 33.66 | 31.94 | 29.26 | 25.69 | 26.31 |
| SO BUILDWID S9C | 30.15 | 33.08 | 35.00 | 35.86 | 35.63 | 34.31 |
| SO BUILDWID S9C | 31.95 | 28.63 | 26.94 | 30.24 | 32.62 | 34.00 |
| SO BUILDWID S9C | 34.35 | 33.66 | 31.94 | 29.26 | 25.68 | 26.31 |
| SO BUILDWID S9C | 30.15 | 33.08 | 35.00 | 35.86 | 35.63 | 34.31 |
| SO BUILDWID S9C | 31.95 | 28.63 | 26.94 | 30.24 | 32.62 | 34.00 |
| SO BUILDHGT S10C | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 |
| SO BUILDHGT S10C | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 |
| SO BUILDHGT S10C | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 |

| | | | | | | | |
|------------------|-------|-------|--------|--------|--------|--------|--------|
| SO BUILDHGT S10C | 5.49 | 5.49 | 5.49 | 17.37 | 17.37 | 17.37 | 17.37 |
| SO BUILDHGT S10C | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 | 17.37 |
| SO BUILDHGT S10C | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 | 5.49 |
| SO BUILDWID S10C | 20.80 | 18.96 | 16.55 | 84.36 | 69.20 | 68.80 | 68.80 |
| SO BUILDWID S10C | 83.87 | 96.40 | 106.00 | 112.38 | 115.34 | 114.80 | 114.80 |
| SO BUILDWID S10C | 23.55 | 22.94 | 22.95 | 22.38 | 22.53 | 22.00 | 22.00 |
| SO BUILDWID S10C | 20.80 | 18.96 | 16.55 | 84.36 | 69.20 | 68.80 | 68.80 |
| SO BUILDWID S10C | 83.87 | 96.40 | 106.00 | 112.38 | 115.34 | 114.80 | 114.80 |
| SO BUILDWID S10C | 23.55 | 22.94 | 22.95 | 22.38 | 22.53 | 22.00 | 22.00 |

SO SRCGROUP CT CT1
SO SRCGROUP CO2 S1C-S10C
SO FINISHED

RE STARTING
RE ELEVUNIT FEET
RE DISCCART 744522. 3982825. 1120. 36.0
RE FINISHED

ME STARTING
*** all windspeeds <.7 m/sec set equal zero (calm)
ME INPUTFIL ORNA8.ASC
ME ANEMHGHT 9.100 METERS
ME SURFDATA 13891 1991 ORTN
ME UAIRDATA 13897 1991 NATN
ME WINDCATS 1.54 3.09 5.14 8.23 10.80
ME FINISHED

OU STARTING
OU MAXTABLE ALLAVE 50
OU MAXIFILE 1 CT .1 WB12CT.SUM
OU MAXIFILE 1 CO2 .1 WB12CO2.SUM
OU FINISHED

*** Message Summary For ISC3 Model Setup ***

----- Summary of Total Messages -----

| | | |
|------------|---|--------------------------|
| A Total of | 0 | Fatal Error Message(s) |
| A Total of | 1 | Warning Message(s) |
| A Total of | 0 | Informational Message(s) |

***** FATAL ERROR MESSAGES *****
*** NONE ***

```
***** WARNING MESSAGES *****
CO W205      9 FLAGDF:No Option Parameter Setting. Forced by Default to ZFLAG=0.
*****
*****
*** SETUP Finishes Successfully ***
*****
```

I-11

```
**Misc. Inputs: Anem. Hgt. (m) = 9.10 ; Decay Coef. = 0.0000 ; Rot. Angle = 0.0  
Emission Units = GRAMS/SEC ; Emission Rate Unit Factor = 0.10000E+07  
Output Units = MICROGRAMS/M**3  
  
**Input Runstream File: wb12.inp ; **Output Print File: wb12.out  
**Detailed Error/Message File: ERRORS.OUT
```

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PAGE 2***
****** ISCST3 - VERSION 97363 ***
*** CT & 10 STACKS @ MON. TOWER*4MW*1991 JUL-SEP WB MET

**MODELOPTS: CONC RURAL ELEV FLGPOL DEFAULT

*** POINT SOURCE DATA ***

| SOURCE ID | NUMBER PART. CATS. | EMISSION RATE (GRAMS/SEC) | X (METERS) | Y (METERS) | BASE ELEV. (METERS) | STACK HEIGHT (METERS) | STACK TEMP. (DEG.K) | STACK EXIT VEL. (M/SEC) | STACK DIAMETER (METERS) | BUILDING EXISTS | EMISSION RATE SCALAR VARY BY |
|--------------|--------------------------|------------------------------|---------------|---------------|---------------------------|-----------------------------|---------------------------|-------------------------------|-------------------------------|--------------------|------------------------------------|
| CT1 | 0 | 0.22015E+05 | 743267.0 | 3981595.0 | 317.0 | 7.52 | 304.80 | 9.80 | 4.88 | YES | |
| S1C | 0 | 0.55230E+02 | 742933.0 | 3981537.0 | 316.8 | 13.56 | 480.00 | 7.18 | 0.41 | YES | |
| S2C | 0 | 0.43150E+02 | 743170.0 | 3981701.0 | 321.3 | 9.14 | 480.00 | 7.18 | 0.30 | YES | |
| S3C | 0 | 0.55230E+02 | 743471.0 | 3981795.0 | 331.6 | 8.53 | 480.00 | 7.18 | 0.41 | YES | |
| S4C | 0 | 0.28290E+02 | 743552.0 | 3981865.0 | 317.3 | 14.93 | 480.00 | 7.18 | 0.25 | YES | |
| S5C | 0 | 0.10273E+03 | 743645.0 | 3981965.0 | 316.5 | 20.42 | 480.00 | 7.18 | 0.41 | YES | |
| S6C | 0 | 0.37420E+02 | 743239.0 | 3981635.0 | 320.0 | 7.92 | 480.00 | 7.18 | 0.30 | YES | |
| S7C | 0 | 0.19660E+02 | 743347.0 | 3981717.0 | 320.0 | 11.58 | 480.00 | 7.18 | 0.20 | YES | |
| S8C | 0 | 0.10273E+03 | 743567.0 | 3982073.0 | 316.5 | 20.42 | 480.00 | 7.18 | 0.41 | YES | |
| S9C | 0 | 0.55230E+02 | 743339.0 | 3981977.0 | 331.6 | 8.53 | 480.00 | 7.18 | 0.41 | YES | |
| S10C | 0 | 0.28290E+02 | 743447.0 | 3982027.0 | 317.3 | 14.93 | 480.00 | 7.18 | 0.25 | YES | |

CO2 : S1C , S2C , S3C , S4C , S5C , S6C , S7C , S8C , S9C , S10C ,

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PAGE 4***
****** CT & 10 STACKS @ MON. TOWER*4MW*1991 JUL-SEP WB MET

*** ISCST3 - VERSION 97363 ***

**MODELOPTS: CONC

RURAL ELEV FLGPOL DEFAULT

*** DIRECTION SPECIFIC BUILDING DIMENSIONS ***

SOURCE ID: CT1

| IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK |
|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|
| 1 | 7.5 | 79.0 | 0 | 2 | 7.5 | 67.6 | 0 | 3 | 7.5 | 54.2 | 0 | 4 | 7.5 | 39.1 | 0 | 5 | 7.5 | 22.9 | 0 |
| 7 | 7.5 | 36.2 | 0 | 8 | 7.5 | 50.9 | 0 | 9 | 7.5 | 64.0 | 0 | 10 | 7.5 | 75.2 | 0 | 11 | 7.5 | 84.1 | 0 |
| 13 | 7.5 | 94.0 | 0 | 14 | 7.5 | 96.8 | 0 | 15 | 7.5 | 98.2 | 0 | 16 | 7.5 | 97.7 | 0 | 17 | 7.5 | 94.3 | 0 |
| 19 | 7.5 | 79.0 | 0 | 20 | 7.5 | 67.6 | 0 | 21 | 7.5 | 54.2 | 0 | 22 | 7.5 | 39.1 | 0 | 23 | 7.5 | 22.9 | 0 |
| 25 | 7.5 | 36.2 | 0 | 26 | 7.5 | 50.9 | 0 | 27 | 7.5 | 64.0 | 0 | 28 | 7.5 | 75.2 | 0 | 29 | 7.5 | 84.1 | 0 |
| 31 | 7.5 | 94.0 | 0 | 32 | 7.5 | 96.8 | 0 | 33 | 7.5 | 98.2 | 0 | 34 | 7.5 | 97.7 | 0 | 35 | 7.5 | 94.3 | 0 |

SOURCE ID: S1C

| IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK |
|-----|------|------|-----|-----|------|------|-----|-----|------|------|-----|-----|------|------|-----|-----|------|------|-----|
| 1 | 10.5 | 39.6 | 0 | 2 | 10.5 | 37.9 | 0 | 3 | 10.5 | 35.1 | 0 | 4 | 10.5 | 31.3 | 0 | 5 | 10.5 | 26.5 | 0 |
| 7 | 10.5 | 28.5 | 0 | 8 | 10.5 | 29.7 | 0 | 9 | 10.5 | 30.0 | 0 | 10 | 10.5 | 31.7 | 0 | 11 | 10.5 | 33.4 | 0 |
| 13 | 10.5 | 33.8 | 0 | 14 | 10.5 | 32.4 | 0 | 15 | 10.5 | 34.1 | 0 | 16 | 10.5 | 37.3 | 0 | 17 | 10.5 | 39.2 | 0 |
| 19 | 10.5 | 39.6 | 0 | 20 | 10.5 | 37.9 | 0 | 21 | 10.5 | 35.1 | 0 | 22 | 10.5 | 31.3 | 0 | 23 | 10.5 | 26.5 | 0 |
| 25 | 10.5 | 28.5 | 0 | 26 | 10.5 | 29.7 | 0 | 27 | 10.5 | 30.0 | 0 | 28 | 10.5 | 31.7 | 0 | 29 | 10.5 | 33.4 | 0 |
| 31 | 10.5 | 33.8 | 0 | 32 | 10.5 | 32.4 | 0 | 33 | 10.5 | 34.1 | 0 | 34 | 10.5 | 37.3 | 0 | 35 | 10.5 | 39.2 | 0 |

SOURCE ID: S2C

| IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK |
|-----|-----|-------|-----|-----|-----|-------|-----|-----|-----|-------|-----|-----|-----|-------|-----|-----|-----|-------|-----|
| 1 | 6.1 | 394.4 | 0 | 2 | 6.1 | 329.8 | 0 | 3 | 6.1 | 255.1 | 0 | 4 | 6.1 | 172.7 | 0 | 5 | 6.1 | 85.1 | 0 |
| 7 | 6.1 | 159.2 | 0 | 8 | 6.1 | 242.8 | 0 | 9 | 6.1 | 319.0 | 0 | 10 | 6.1 | 385.5 | 0 | 11 | 6.1 | 440.3 | 0 |
| 13 | 6.1 | 508.5 | 0 | 14 | 6.1 | 519.9 | 0 | 15 | 6.1 | 519.1 | 0 | 16 | 6.1 | 510.3 | 0 | 17 | 6.1 | 486.0 | 0 |
| 19 | 6.1 | 394.4 | 0 | 20 | 6.1 | 329.8 | 0 | 21 | 6.1 | 255.1 | 0 | 22 | 6.1 | 172.7 | 0 | 23 | 6.1 | 85.1 | 0 |
| 25 | 6.1 | 159.2 | 0 | 26 | 6.1 | 242.8 | 0 | 27 | 6.1 | 319.0 | 0 | 28 | 6.1 | 385.5 | 0 | 29 | 6.1 | 440.3 | 0 |
| 31 | 6.1 | 508.5 | 0 | 32 | 6.1 | 519.9 | 0 | 33 | 6.1 | 519.1 | 0 | 34 | 6.1 | 510.3 | 0 | 35 | 6.1 | 486.0 | 0 |

SOURCE ID: S3C

| IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK |
|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|
| 1 | 5.5 | 33.2 | 0 | 2 | 5.5 | 32.4 | 0 | 3 | 5.5 | 30.6 | 0 | 4 | 5.5 | 27.8 | 0 | 5 | 5.5 | 26.3 | 0 |
| 7 | 5.5 | 32.2 | 0 | 8 | 5.5 | 34.1 | 0 | 9 | 5.5 | 35.0 | 0 | 10 | 5.5 | 34.8 | 0 | 11 | 5.5 | 33.6 | 0 |
| 13 | 5.5 | 28.1 | 0 | 14 | 5.5 | 24.2 | 0 | 15 | 5.5 | 26.6 | 0 | 16 | 5.5 | 29.6 | 0 | 17 | 5.5 | 31.8 | 0 |
| 19 | 5.5 | 33.2 | 0 | 20 | 5.5 | 32.4 | 0 | 21 | 5.5 | 30.6 | 0 | 22 | 5.5 | 27.8 | 0 | 23 | 5.5 | 26.3 | 0 |
| 25 | 5.5 | 32.2 | 0 | 26 | 5.5 | 34.1 | 0 | 27 | 5.5 | 35.0 | 0 | 28 | 5.5 | 34.8 | 0 | 29 | 5.5 | 33.6 | 0 |
| 31 | 5.5 | 28.1 | 0 | 32 | 5.5 | 24.2 | 0 | 33 | 5.5 | 26.6 | 0 | 34 | 5.5 | 29.6 | 0 | 35 | 5.5 | 31.8 | 0 |

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PAGE 5*** ICSCT3 - VERSION 97363 *** ** CT & 10 STACKS @ MON. TOWER*4MW*1991 JUL-SEP WB MET

RURAL ELEV FLGPOOL DEFAULT

**MODELOPTS: CONC

*** DIRECTION SPECIFIC BUILDING DIMENSIONS ***

SOURCE ID: S4C

| IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK |
|-----|------|-------|-----|-----|------|-------|-----|-----|------|-------|-----|-----|------|------|-----|-----|------|------|-----|-----|------|-------|-----|
| 1 | 17.4 | 115.7 | 0 | 2 | 17.4 | 109.9 | 0 | 3 | 17.4 | 100.7 | 0 | 4 | 5.5 | 14.4 | 0 | 5 | 5.5 | 10.9 | 0 | 6 | 5.5 | 10.7 | 0 |
| 7 | 17.4 | 84.0 | 0 | 8 | 5.5 | 18.1 | 0 | 9 | 5.5 | 21.0 | 0 | 10 | 5.5 | 23.3 | 0 | 11 | 5.5 | 24.9 | 0 | 12 | 5.5 | 25.7 | 0 |
| 13 | 5.5 | 25.7 | 0 | 14 | 5.5 | 25.0 | 0 | 15 | 5.5 | 23.5 | 0 | 16 | 5.5 | 23.3 | 0 | 17 | 5.5 | 23.5 | 0 | 18 | 17.4 | 118.0 | 0 |
| 19 | 17.4 | 115.7 | 0 | 20 | 17.4 | 109.9 | 0 | 21 | 17.4 | 100.7 | 0 | 22 | 17.4 | 88.5 | 0 | 23 | 17.4 | 73.6 | 0 | 24 | 17.4 | 67.4 | 0 |
| 25 | 17.4 | 84.0 | 0 | 26 | 5.5 | 18.1 | 0 | 27 | 5.5 | 21.0 | 0 | 28 | 5.5 | 23.3 | 0 | 29 | 5.5 | 24.9 | 0 | 30 | 5.5 | 25.7 | 0 |
| 31 | 5.5 | 25.7 | 0 | 32 | 5.5 | 25.0 | 0 | 33 | 5.5 | 23.5 | 0 | 34 | 5.5 | 23.3 | 0 | 35 | 5.5 | 23.5 | 0 | 36 | 17.4 | 118.0 | 0 |

SOURCE ID: S5C

| IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK |
|-----|------|-------|-----|-----|------|-------|-----|-----|------|-------|-----|-----|------|-------|-----|-----|------|-------|-----|-----|------|-------|-----|
| 1 | 17.4 | 115.7 | 0 | 2 | 17.4 | 109.9 | 0 | 3 | 17.4 | 100.7 | 0 | 4 | 17.4 | 88.5 | 0 | 5 | 17.4 | 73.6 | 0 | 6 | 17.4 | 67.4 | 0 |
| 7 | 17.4 | 84.0 | 0 | 8 | 17.4 | 98.0 | 0 | 9 | 17.4 | 104.8 | 0 | 10 | 17.4 | 116.7 | 0 | 11 | 17.4 | 120.9 | 0 | 12 | 17.4 | 121.4 | 0 |
| 13 | 17.4 | 118.2 | 0 | 14 | 17.4 | 111.4 | 0 | 15 | 17.4 | 109.0 | 0 | 16 | 17.4 | 111.9 | 0 | 17 | 17.4 | 116.7 | 0 | 18 | 17.4 | 118.0 | 0 |
| 19 | 17.4 | 115.7 | 0 | 20 | 17.4 | 109.9 | 0 | 21 | 17.4 | 100.7 | 0 | 22 | 17.4 | 88.5 | 0 | 23 | 17.4 | 73.6 | 0 | 24 | 17.4 | 67.4 | 0 |
| 25 | 17.4 | 84.0 | 0 | 26 | 17.4 | 98.0 | 0 | 27 | 17.4 | 109.0 | 0 | 28 | 17.4 | 116.7 | 0 | 29 | 17.4 | 120.9 | 0 | 30 | 17.4 | 121.4 | 0 |
| 31 | 17.4 | 118.2 | 0 | 32 | 17.4 | 111.4 | 0 | 33 | 17.4 | 104.8 | 0 | 34 | 17.4 | 111.9 | 0 | 35 | 17.4 | 116.7 | 0 | 36 | 17.4 | 118.0 | 0 |

SOURCE ID: S6C

| IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK |
|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|
| 1 | 4.9 | 47.2 | 0 | 2 | 4.9 | 42.9 | 0 | 3 | 4.9 | 37.3 | 0 | 4 | 4.9 | 30.6 | 0 | 5 | 4.9 | 22.9 | 0 | 6 | 4.9 | 23.1 | 0 |
| 7 | 4.9 | 31.1 | 0 | 8 | 4.9 | 38.1 | 0 | 9 | 4.9 | 44.0 | 0 | 10 | 4.9 | 48.5 | 0 | 11 | 4.9 | 51.6 | 0 | 12 | 4.9 | 53.1 | 0 |
| 13 | 4.9 | 53.0 | 0 | 14 | 4.9 | 51.3 | 0 | 15 | 4.9 | 49.3 | 0 | 16 | 4.9 | 51.1 | 0 | 17 | 4.9 | 51.3 | 0 | 18 | 4.9 | 50.0 | 0 |
| 19 | 4.9 | 47.2 | 0 | 20 | 4.9 | 42.9 | 0 | 21 | 4.9 | 37.3 | 0 | 22 | 4.9 | 30.6 | 0 | 23 | 4.9 | 22.9 | 0 | 24 | 4.9 | 23.1 | 0 |
| 25 | 4.9 | 31.1 | 0 | 26 | 4.9 | 38.1 | 0 | 27 | 4.9 | 44.0 | 0 | 28 | 4.9 | 48.5 | 0 | 29 | 4.9 | 51.6 | 0 | 30 | 4.9 | 53.1 | 0 |
| 31 | 4.9 | 53.0 | 0 | 32 | 4.9 | 51.3 | 0 | 33 | 4.9 | 49.3 | 0 | 34 | 4.9 | 51.1 | 0 | 35 | 4.9 | 51.3 | 0 | 36 | 4.9 | 50.0 | 0 |

SOURCE ID: S7C

| IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK |
|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|
| 1 | 8.5 | 51.2 | 0 | 2 | 8.5 | 54.8 | 0 | 3 | 8.5 | 56.8 | 0 | 4 | 8.5 | 57.1 | 0 | 5 | 8.5 | 55.6 | 0 | 6 | 8.5 | 55.5 | 0 |
| 7 | 8.5 | 58.9 | 0 | 8 | 8.5 | 61.4 | 0 | 9 | 8.5 | 62.0 | 0 | 10 | 8.5 | 60.7 | 0 | 11 | 8.5 | 57.6 | 0 | 12 | 8.5 | 52.7 | 0 |
| 13 | 8.5 | 46.3 | 0 | 14 | 8.5 | 41.4 | 0 | 15 | 8.5 | 44.1 | 0 | 16 | 8.5 | 45.5 | 0 | 17 | 8.5 | 45.4 | 0 | 18 | 8.5 | 46.0 | 0 |
| 19 | 8.5 | 51.2 | 0 | 20 | 8.5 | 54.8 | 0 | 21 | 8.5 | 56.8 | 0 | 22 | 8.5 | 57.1 | 0 | 23 | 8.5 | 55.6 | 0 | 24 | 8.5 | 55.5 | 0 |
| 25 | 8.5 | 58.9 | 0 | 26 | 8.5 | 61.4 | 0 | 27 | 8.5 | 62.0 | 0 | 28 | 8.5 | 60.7 | 0 | 29 | 8.5 | 57.6 | 0 | 30 | 8.5 | 52.7 | 0 |
| 31 | 8.5 | 46.3 | 0 | 32 | 8.5 | 41.4 | 0 | 33 | 8.5 | 44.1 | 0 | 34 | 8.5 | 45.5 | 0 | 35 | 8.5 | 45.4 | 0 | 36 | 8.5 | 46.0 | 0 |

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PAGE 6***
****** CT & 10 STACKS @ MON. TOWER*4MW*1991 JUL-SEP WB MET

*** ISCST3 - VERSION 97363 ***

**MODELOPTs: CONC

RURAL ELEV FLGPOL DFAULT

*** DIRECTION SPECIFIC BUILDING DIMENSIONS ***

SOURCE ID: S8C

| IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK |
|-----|------|-------|-----|-----|------|-------|-----|-----|------|-------|-----|-----|------|-------|-----|-----|------|-------|-----|-----|------|-------|-----|
| 1 | 17.4 | 113.0 | 0 | 2 | 17.4 | 106.6 | 0 | 3 | 17.4 | 97.0 | 0 | 4 | 17.4 | 84.4 | 0 | 5 | 17.4 | 69.2 | 0 | 6 | 17.4 | 68.8 | 0 |
| 7 | 17.4 | 83.9 | 0 | 8 | 17.4 | 96.4 | 0 | 9 | 17.4 | 106.0 | 0 | 10 | 17.4 | 112.4 | 0 | 11 | 17.4 | 115.3 | 0 | 12 | 17.4 | 114.8 | 0 |
| 13 | 17.4 | 110.8 | 0 | 14 | 17.4 | 103.4 | 0 | 15 | 17.4 | 104.0 | 0 | 16 | 17.4 | 111.4 | 0 | 17 | 17.4 | 115.5 | 0 | 18 | 17.4 | 116.0 | 0 |
| 19 | 17.4 | 113.0 | 0 | 20 | 17.4 | 106.6 | 0 | 21 | 17.4 | 97.0 | 0 | 22 | 17.4 | 84.4 | 0 | 23 | 17.4 | 69.2 | 0 | 24 | 17.4 | 68.8 | 0 |
| 25 | 17.4 | 83.9 | 0 | 26 | 17.4 | 96.4 | 0 | 27 | 17.4 | 106.0 | 0 | 28 | 17.4 | 112.4 | 0 | 29 | 17.4 | 115.3 | 0 | 30 | 17.4 | 114.8 | 0 |
| 31 | 17.4 | 110.8 | 0 | 32 | 17.4 | 103.4 | 0 | 33 | 17.4 | 104.0 | 0 | 34 | 17.4 | 111.4 | 0 | 35 | 17.4 | 115.5 | 0 | 36 | 17.4 | 116.0 | 0 |

SOURCE ID: S9C

| IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK |
|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|
| 1 | 5.5 | 34.3 | 0 | 2 | 5.5 | 33.7 | 0 | 3 | 5.5 | 31.9 | 0 | 4 | 5.5 | 29.3 | 0 | 5 | 5.5 | 25.7 | 0 | 6 | 5.5 | 26.3 | 0 |
| 7 | 5.5 | 30.1 | 0 | 8 | 5.5 | 33.1 | 0 | 9 | 5.5 | 35.0 | 0 | 10 | 5.5 | 35.9 | 0 | 11 | 5.5 | 35.6 | 0 | 12 | 5.5 | 34.3 | 0 |
| 13 | 5.5 | 31.9 | 0 | 14 | 5.5 | 28.6 | 0 | 15 | 5.5 | 26.9 | 0 | 16 | 5.5 | 30.2 | 0 | 17 | 5.5 | 32.6 | 0 | 18 | 5.5 | 34.0 | 0 |
| 19 | 5.5 | 34.3 | 0 | 20 | 5.5 | 33.7 | 0 | 21 | 5.5 | 31.9 | 0 | 22 | 5.5 | 29.3 | 0 | 23 | 5.5 | 25.7 | 0 | 24 | 5.5 | 26.3 | 0 |
| 25 | 5.5 | 30.1 | 0 | 26 | 5.5 | 33.1 | 0 | 27 | 5.5 | 35.0 | 0 | 28 | 5.5 | 35.9 | 0 | 29 | 5.5 | 35.6 | 0 | 30 | 5.5 | 34.3 | 0 |
| 31 | 5.5 | 31.9 | 0 | 32 | 5.5 | 28.6 | 0 | 33 | 5.5 | 26.9 | 0 | 34 | 5.5 | 30.2 | 0 | 35 | 5.5 | 32.6 | 0 | 36 | 5.5 | 34.0 | 0 |

SOURCE ID: S10C

| IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK | IFV | BH | BW | WAK |
|-----|------|------|-----|-----|------|------|-----|-----|------|-------|-----|-----|------|-------|-----|-----|------|-------|-----|-----|------|-------|-----|
| 1 | 5.5 | 20.8 | 0 | 2 | 5.5 | 19.0 | 0 | 3 | 5.5 | 16.5 | 0 | 4 | 17.4 | 84.4 | 0 | 5 | 17.4 | 69.2 | 0 | 6 | 17.4 | 68.8 | 0 |
| 7 | 17.4 | 83.9 | 0 | 8 | 17.4 | 96.4 | 0 | 9 | 17.4 | 106.0 | 0 | 10 | 17.4 | 112.4 | 0 | 11 | 17.4 | 115.3 | 0 | 12 | 17.4 | 114.8 | 0 |
| 13 | 5.5 | 23.5 | 0 | 14 | 5.5 | 22.9 | 0 | 15 | 5.5 | 22.9 | 0 | 16 | 5.5 | 22.4 | 0 | 17 | 5.5 | 22.5 | 0 | 18 | 5.5 | 22.0 | 0 |
| 19 | 5.5 | 20.8 | 0 | 20 | 5.5 | 19.0 | 0 | 21 | 5.5 | 16.5 | 0 | 22 | 17.4 | 84.4 | 0 | 23 | 17.4 | 69.2 | 0 | 24 | 17.4 | 68.8 | 0 |
| 25 | 17.4 | 83.9 | 0 | 26 | 17.4 | 96.4 | 0 | 27 | 17.4 | 106.0 | 0 | 28 | 17.4 | 112.4 | 0 | 29 | 17.4 | 115.3 | 0 | 30 | 17.4 | 114.8 | 0 |
| 31 | 5.5 | 23.5 | 0 | 32 | 5.5 | 22.9 | 0 | 33 | 5.5 | 22.9 | 0 | 34 | 5.5 | 22.4 | 0 | 35 | 5.5 | 22.5 | 0 | 36 | 5.5 | 22.0 | 0 |

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*** CT & 10 STACKS @ MON. TOWER*4MW*1991 JUL-SEP WB MET

*** ISCST3 - VERSION 97363 ***

**MODELOPTS: CONC

RURAL ELEV FLGPOL DFAULT

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZFLAG)
(METERS)

(744522.0, 3982825.0, 341.4, 36.0);

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*** ISCS3 - VERSION 97363 *** ** CT & 10 STACKS @ MON. TOWER*4MW*1991 JUL-SEP WB MET ***

**MODELOPTS: CONC RURAL ELEV FLGPOL DEFAULT

*** THE FIRST 24 HOURS OF METEOROLOGICAL DATA ***

FILE: ORNAB.ASC
 SURFACE STATION NO.: 13891
 NAME: ORTN
 YEAR: 1991

FORMAT: (4I2,2F9.4,F6.1,I2,2F7.1,f9.4,f10.1,f8.4,i4,f7.2)
 UPPER AIR STATION NO.: 13897
 NAME: NATN
 YEAR: 1991

| YR | MN | DY | HR | FLOW VECTOR | SPEED (M/S) | TEMP (K) | STAB CLASS | MIXING RURAL | HEIGHT URBAN | USTAR (M/S) | M-O LENGTH (M) | Z-0 (M) | IPCODE | PRATE (mm/HR) |
|----|----|----|----|-------------|-------------|----------|------------|--------------|--------------|-------------|----------------|---------|--------|---------------|
| 91 | 1 | 1 | 1 | 32.0 | 1.82 | 303.1 | 2 | 2125.8 | 2161.9 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |
| 91 | 1 | 1 | 2 | 52.1 | 2.30 | 303.2 | 3 | 2196.4 | 2223.4 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |
| 91 | 1 | 1 | 3 | 97.4 | 3.72 | 302.8 | 2 | 2266.9 | 2284.9 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |
| 91 | 1 | 1 | 4 | 119.5 | 3.90 | 300.0 | 3 | 2337.4 | 2346.5 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |
| 91 | 1 | 1 | 5 | 104.3 | 3.39 | 298.1 | 3 | 2408.0 | 2408.0 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |
| 91 | 1 | 1 | 6 | 122.6 | 2.57 | 297.3 | 4 | 2408.0 | 2408.0 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |
| 91 | 1 | 1 | 7 | 108.5 | 2.71 | 297.2 | 3 | 2408.0 | 2408.0 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |
| 91 | 1 | 1 | 8 | 120.6 | 2.76 | 297.4 | 4 | 2408.0 | 2408.0 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |
| 91 | 1 | 1 | 9 | 134.4 | 2.15 | 298.5 | 4 | 2408.0 | 2408.0 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |
| 91 | 1 | 1 | 10 | 99.4 | 1.20 | 300.6 | 1 | 2408.0 | 2408.0 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |
| 91 | 1 | 1 | 11 | 106.0 | 1.38 | 301.9 | 2 | 2408.0 | 2408.0 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |
| 91 | 1 | 1 | 12 | 113.0 | 1.24 | 302.7 | 2 | 2408.0 | 2408.0 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |
| 91 | 1 | 1 | 13 | 98.5 | 1.38 | 303.6 | 4 | 2408.0 | 2408.0 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |
| 91 | 1 | 1 | 14 | 120.9 | 1.13 | 303.6 | 4 | 2408.0 | 2408.0 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |
| 91 | 1 | 1 | 15 | 123.5 | 0.00 | 304.4 | 3 | 2408.0 | 2408.0 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |
| 91 | 1 | 1 | 16 | 9.2 | 0.78 | 304.0 | 1 | 2408.0 | 2408.0 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |
| 91 | 1 | 1 | 17 | 11.2 | 0.98 | 302.5 | 4 | 2408.0 | 2408.0 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |
| 91 | 1 | 1 | 18 | 312.1 | 0.78 | 302.1 | 4 | 2408.0 | 2408.0 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |
| 91 | 1 | 1 | 19 | 250.0 | 0.00 | 301.9 | 3 | 2408.0 | 2408.0 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |
| 91 | 1 | 1 | 20 | 144.0 | 1.88 | 301.4 | 3 | 2408.0 | 2408.0 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |
| 91 | 1 | 1 | 21 | 128.3 | 4.62 | 299.7 | 4 | 2408.0 | 2408.0 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |
| 91 | 1 | 1 | 22 | 114.9 | 5.02 | 298.3 | 4 | 2408.0 | 2408.0 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |
| 91 | 1 | 1 | 23 | 88.2 | 7.96 | 296.5 | 4 | 2408.0 | 2408.0 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |
| 91 | 1 | 1 | 24 | 81.5 | 5.35 | 293.9 | 4 | 2408.0 | 2408.0 | 0.0000 | 0.0 | 0.0000 | 0 | 0.00 |

*** NOTES: STABILITY CLASS 1=A, 2=B, 3=C, 4=D, 5=E AND 6=F.
 FLOW VECTOR IS DIRECTION TOWARD WHICH WIND IS BLOWING.

06/15/98
19:41:09
PAGE 10*** CT & 10 STACKS @ MON. TOWER*4MW*1991 JUL-SEP WB MET

*** ISCST3 - VERSION 97363 ***

**MODELOPTS: CONC

RURAL ELEV FLGPOL DEFAULT

*** THE MAXIMUM 50 1-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: CT ***
INCLUDING SOURCE(S): CT1

** CONC OF OTHER IN MICROGRAMS/M**3

| RANK | CONC | (YYMMDDHH) AT | RECEPTOR (XR, YR) OF TYPE | RANK | CONC | (YYMMDDHH) AT | RECEPTOR (XR, YR) OF TYPE |
|------|---------------|---------------|-----------------------------|------|--------------|---------------|-----------------------------|
| 1. | 1040519.44000 | (91052301) AT | (744522.00, 3982825.00) DC | 26. | 408944.15600 | (91103013) AT | (744522.00, 3982825.00) DC |
| 2. | 860371.37500 | (91071318) AT | (744522.00, 3982825.00) DC | 27. | 407653.59400 | (91041610) AT | (744522.00, 3982825.00) DC |
| 3. | 852523.31300 | (91021122) AT | (744522.00, 3982825.00) DC | 28. | 407477.68800 | (91071319) AT | (744522.00, 3982825.00) DC |
| 4. | 730122.50000 | (91062409) AT | (744522.00, 3982825.00) DC | 29. | 406411.00000 | (91053015) AT | (744522.00, 3982825.00) DC |
| 5. | 715342.68800 | (91032316) AT | (744522.00, 3982825.00) DC | 30. | 406308.28100 | (91012307) AT | (744522.00, 3982825.00) DC |
| 6. | 661015.50000 | (91122008) AT | (744522.00, 3982825.00) DC | 31. | 403909.93800 | (91011924) AT | (744522.00, 3982825.00) DC |
| 7. | 588806.12500 | (91122006) AT | (744522.00, 3982825.00) DC | 32. | 401106.93800 | (91051419) AT | (744522.00, 3982825.00) DC |
| 8. | 566632.50000 | (91031924) AT | (744522.00, 3982825.00) DC | 33. | 398889.31300 | (91051006) AT | (744522.00, 3982825.00) DC |
| 9. | 528942.06300 | (91090713) AT | (744522.00, 3982825.00) DC | 34. | 390928.28100 | (91082716) AT | (744522.00, 3982825.00) DC |
| 10. | 522100.75000 | (91031210) AT | (744522.00, 3982825.00) DC | 35. | 387549.31300 | (91051422) AT | (744522.00, 3982825.00) DC |
| 11. | 505200.96900 | (91050223) AT | (744522.00, 3982825.00) DC | 36. | 384416.31300 | (91120224) AT | (744522.00, 3982825.00) DC |
| 12. | 495518.90600 | (91081406) AT | (744522.00, 3982825.00) DC | 37. | 376056.21900 | (91030411) AT | (744522.00, 3982825.00) DC |
| 13. | 484229.78100 | (91051024) AT | (744522.00, 3982825.00) DC | 38. | 374980.28100 | (91100124) AT | (744522.00, 3982825.00) DC |
| 14. | 484089.75000 | (91051012) AT | (744522.00, 3982825.00) DC | 39. | 374238.78100 | (91041723) AT | (744522.00, 3982825.00) DC |
| 15. | 458267.34400 | (91091508) AT | (744522.00, 3982825.00) DC | 40. | 370532.78100 | (91100202) AT | (744522.00, 3982825.00) DC |
| 16. | 452520.68800 | (91101006) AT | (744522.00, 3982825.00) DC | 41. | 368265.96900 | (91051414) AT | (744522.00, 3982825.00) DC |
| 17. | 451771.87500 | (91042012) AT | (744522.00, 3982825.00) DC | 42. | 367364.46900 | (91122813) AT | (744522.00, 3982825.00) DC |
| 18. | 447626.53100 | (91110306) AT | (744522.00, 3982825.00) DC | 43. | 359781.78100 | (91110402) AT | (744522.00, 3982825.00) DC |
| 19. | 436331.84400 | (91070504) AT | (744522.00, 3982825.00) DC | 44. | 352743.71900 | (91021209) AT | (744522.00, 3982825.00) DC |
| 20. | 434912.84400 | (91013015) AT | (744522.00, 3982825.00) DC | 45. | 351305.65600 | (91011914) AT | (744522.00, 3982825.00) DC |
| 21. | 431920.71900 | (91082706) AT | (744522.00, 3982825.00) DC | 46. | 349772.53100 | (91032315) AT | (744522.00, 3982825.00) DC |
| 22. | 414508.93800 | (91012304) AT | (744522.00, 3982825.00) DC | 47. | 344577.96900 | (91122005) AT | (744522.00, 3982825.00) DC |
| 23. | 413562.81300 | (91050716) AT | (744522.00, 3982825.00) DC | 48. | 343476.03100 | (91122814) AT | (744522.00, 3982825.00) DC |
| 24. | 411230.18800 | (91081509) AT | (744522.00, 3982825.00) DC | 49. | 337569.43800 | (91052401) AT | (744522.00, 3982825.00) DC |
| 25. | 410081.40600 | (91042020) AT | (744522.00, 3982825.00) DC | 50. | 334396.34400 | (91101824) AT | (744522.00, 3982825.00) DC |

*** RECEPTOR TYPES: GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR
BD = BOUNDARY

06/15/98
19:41:09
PAGE 11

*** CT & 10 STACKS @ MON. TOWER*4MW*1991 JUL-SEP WB MET

*** ISCST3 - VERSION 97363 ***

**MODELOPTS: CONC RURAL ELEV FLGPOL DEFAULT

*** THE MAXIMUM 50 1-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: CO2 ***
INCLUDING SOURCE(S): S1C , S2C , S3C , S4C , S5C , S6C , S7C , S8C , S9C , S10C ,

| ** CONC OF OTHER IN MICROGRAMS/M**3 | | | | | | | | | |
|-------------------------------------|-------------|---------------|-----------------------------|------|-------------|---------------|-----------------------------|--|--|
| RANK | CONC | (YYMMDDHH) AT | RECEPTOR (XR, YR) OF TYPE | RANK | CONC | (YYMMDDHH) AT | RECEPTOR (XR, YR) OF TYPE | | |
| 1. | 23410.70120 | (91071812) AT | (744522.00, 3982825.00) DC | 26. | 17071.55470 | (91062409) AT | (744522.00, 3982825.00) DC | | |
| 2. | 21986.40040 | (91032316) AT | (744522.00, 3982825.00) DC | 27. | 16991.44140 | (91032418) AT | (744522.00, 3982825.00) DC | | |
| 3. | 21535.64450 | (91120224) AT | (744522.00, 3982825.00) DC | 28. | 16965.68750 | (91020413) AT | (744522.00, 3982825.00) DC | | |
| 4. | 20892.60940 | (91081509) AT | (744522.00, 3982825.00) DC | 29. | 16848.01560 | (91082716) AT | (744522.00, 3982825.00) DC | | |
| 5. | 20041.11330 | (91051421) AT | (744522.00, 3982825.00) DC | 30. | 16829.27340 | (91112409) AT | (744522.00, 3982825.00) DC | | |
| 6. | 20030.30660 | (91040123) AT | (744522.00, 3982825.00) DC | 31. | 16754.21090 | (91082516) AT | (744522.00, 3982825.00) DC | | |
| 7. | 19808.75980 | (91020822) AT | (744522.00, 3982825.00) DC | 32. | 16634.74020 | (91100218) AT | (744522.00, 3982825.00) DC | | |
| 8. | 19677.09960 | (91011924) AT | (744522.00, 3982825.00) DC | 33. | 16623.85740 | (91012001) AT | (744522.00, 3982825.00) DC | | |
| 9. | 19644.17970 | (91010308) AT | (744522.00, 3982825.00) DC | 34. | 16616.91020 | (91123123) AT | (744522.00, 3982825.00) DC | | |
| 10. | 19468.10550 | (91082621) AT | (744522.00, 3982825.00) DC | 35. | 16578.47850 | (91071318) AT | (744522.00, 3982825.00) DC | | |
| 11. | 19457.75000 | (91090713) AT | (744522.00, 3982825.00) DC | 36. | 16355.34860 | (91110402) AT | (744522.00, 3982825.00) DC | | |
| 12. | 19398.85160 | (91071507) AT | (744522.00, 3982825.00) DC | 37. | 16330.78220 | (91100423) AT | (744522.00, 3982825.00) DC | | |
| 13. | 18869.52930 | (91071319) AT | (744522.00, 3982825.00) DC | 38. | 16329.21580 | (91050711) AT | (744522.00, 3982825.00) DC | | |
| 14. | 18642.33980 | (91032315) AT | (744522.00, 3982825.00) DC | 39. | 16133.59860 | (91120405) AT | (744522.00, 3982825.00) DC | | |
| 15. | 18337.98050 | (91103013) AT | (744522.00, 3982825.00) DC | 40. | 16127.61620 | (91031210) AT | (744522.00, 3982825.00) DC | | |
| 16. | 18333.78710 | (91050716) AT | (744522.00, 3982825.00) DC | 41. | 15932.03130 | (91091421) AT | (744522.00, 3982825.00) DC | | |
| 17. | 18156.91020 | (91100422) AT | (744522.00, 3982825.00) DC | 42. | 15881.87790 | (91112318) AT | (744522.00, 3982825.00) DC | | |
| 18. | 17871.23240 | (91030411) AT | (744522.00, 3982825.00) DC | 43. | 15826.50290 | (91122009) AT | (744522.00, 3982825.00) DC | | |
| 19. | 17843.57420 | (91040321) AT | (744522.00, 3982825.00) DC | 44. | 15798.71290 | (91062103) AT | (744522.00, 3982825.00) DC | | |
| 20. | 17636.11520 | (91052301) AT | (744522.00, 3982825.00) DC | 45. | 15557.46880 | (91112315) AT | (744522.00, 3982825.00) DC | | |
| 21. | 17512.26170 | (91091619) AT | (744522.00, 3982825.00) DC | 46. | 15491.74800 | (91031905) AT | (744522.00, 3982825.00) DC | | |
| 22. | 17505.71290 | (91091610) AT | (744522.00, 3982825.00) DC | 47. | 15443.38180 | (91041616) AT | (744522.00, 3982825.00) DC | | |
| 23. | 17472.12110 | (91100420) AT | (744522.00, 3982825.00) DC | 48. | 15405.26950 | (91031924) AT | (744522.00, 3982825.00) DC | | |
| 24. | 17386.54490 | (91110307) AT | (744522.00, 3982825.00) DC | 49. | 15323.43360 | (91051419) AT | (744522.00, 3982825.00) DC | | |
| 25. | 17223.24020 | (91121006) AT | (744522.00, 3982825.00) DC | 50. | 14943.97560 | (91101006) AT | (744522.00, 3982825.00) DC | | |

*** RECEPTOR TYPES: GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR
BD = BOUNDARY

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